CLAIMS

WHAT IS CLAIMED IS:

1. A position detection system for locating an object including a magnetic field generator, comprising:

an array of parallel conductors responsive to a magnetic field generated by the magnetic field generator; and

a plurality of receivers each associated with a parallel conductor.

2. The system as recited in claim 1, wherein the array of parallel conductors is configured to locate the object along a measurement path.

3. The system as recited in claim 2, wherein the measurement path comprises a measurement axis, and the array of parallel conductors is orthogonal to the measurement axis.

4. The system as recited in claim 1, further comprising a plurality of drivers each associated with a parallel conductor and configured to drive current through to produce an energizing field.

5. The system as recited in claim 4, wherein at least one driver is configured to send current through the associated parallel conductor in one direction, and at least one driver is configured to send current through the associated parallel conductor in an opposite direction.

6. The system as recited in claim 5, wherein the drivers are configured so that net current through the array of parallel conductors is substantially zero.

7. The system as recited in claim 6, further comprising a return conductor configured to balance current between the drivers.

8. The system as recited in claim 7, wherein the return conductor is disposed such that current passing through produces a constant offset to the energizing fields produced by the array of parallel conductors.

9. The system as recited in claim 8, wherein the return conductor is disposed at an end of the array of parallel conductors.

10. The system as recited in claim 4, wherein the magnetic field generator includes a resonator that is energized by the energizing field.

11. The system as recited in claim 10, wherein the resonator includes an inductor and capacitor.

12. The system as recited in claim 1, wherein the parallel conductors are spaced apart from one another in a sinusoidally varying manner.

13. The system as recited in claim 12, wherein the parallel conductors are oriented orthogonal to an axis along which the location of the object is measured, and the spacing of the parallel conductors varies according to a sine of each parallel conductor's position along the axis.

14. The system as recited in claim 13, further comprising a plurality of drivers each associated with a parallel conductor and configured to drive current through to produce an energizing field.

15. The system as recited in claim 14, wherein the drivers are configured to produce a desired energizing field profile.

16. The system as recited in claim 15, wherein the desired energizing field profile has a spatial frequency and phase that are adjusted by configuring the drivers to produce a profile of driving currents.

17. The system as recited in claim 16, wherein producing the profile of driving currents includes adjusting at least one of current amplitude, frequency, and phase for each driver.

18. The system as recited in claim 14, wherein the drivers are configured to produce a substantially uniform energizing field energy along the axis.

19. The system as recited in claim 14, wherein the drivers are configured such that drive current is increased in parallel conductors that are spaced further apart and decreased in parallel conductors that are spaced closer together.

20. The system as recited in claim 14, wherein drive current in each parallel conductor varies according to a cosine of the parallel conductor's position along the axis.

21. The system as recited in claim 20, wherein the magnetic field generator includes a resonator that is energized by the energizing field.

22. The system as recited in claim 21, wherein the resonator includes an inductor and capacitor.

23. The system as recited in claim 1, wherein the parallel conductors are spaced apart from one another by a substantially constant spacing.

24. The system as recited in claim 23, wherein each receiver has an associated gain, and wherein the gains of the receivers are configured to simulate voltages induced in conductor loops of sinusoidally-varying pitch.

25. The system as recited in claim 23, wherein each receiver has an associated gain, and wherein the gains of the receivers are configured to produce a desired profile.

26. The system as recited in claim 25, wherein the desired profile includes at least one of a desired frequency and a desired phase.

27. The system as recited in claim 26, wherein the desired profile is a sinusoidal profile.

28. The system as recited in claim 26, wherein the sinusoidal profile is produced by varying each gain sinusoidally according to a position of the parallel conductor in the array of parallel conductors.

29. The system as recited in claim 23, further comprising a plurality of drivers each associated with a parallel conductor and configured to drive a current through to produce an energizing field.

30. The system as recited in claim 29, wherein at least one driver is configured to send current through the associated parallel conductor in one direction, and at least one driver is configured to send current through the associated parallel conductor in an opposite direction.

31. The system as recited in claim 30, wherein the drivers are configured to produce a desired energizing field profile.

32. The system as recited in claim 31, wherein the desired energizing field profile has a spatial frequency and phase that are adjusted by configuring the drivers to produce a profile of driving currents.

33. The system as recited in claim 32, wherein producing the profile of driving currents includes adjusting at least one of current amplitude, frequency, and phase for each driver.

34. The system as recited in claim 32, wherein the desired energizing field profile is configured to detect at least one of height and tilt of the magnetic field generator.

35. The system as recited in claim 34, wherein a plurality of driving current phases in the desired energizing field profile are configured to change an effective angular direction of a resultant energizing field vector.

36. The system as recited in claim 35, further configured to vary the desired energizing field profile to determine a maximum response of a tilted resonator.

37. The system as recited in claim 34, wherein the desired profile is a sinusoidal profile.

38. The system as recited in claim 37, wherein the drivers are configured such that drive current in each parallel conductor is varied sinusoidally according to a position of the parallel conductor in the array of parallel conductors.

39. The system as recited in claim 34, wherein the array of parallel conductors lies in a plane, and the desired energizing field profile is configured to increase energizing field excitation in a vicinity of the object.

40. The system as recited in claim 39, further configured to locate a second object closer to the plane than the object.

41. The system as recited in claim 40, wherein the desired energizing field profile is configured to produce higher energizing field excitation in the vicinity of the object than in a vicinity of the second object.

42. The system as recited in claim 41, configured to provide higher drive current at a resonant frequency of the object than the drive current at a second resonant frequency of the second object.

43. The system as recited in claim 30, wherein the drivers are configured to produce a substantially uniform energizing field energy along the axis.

44. The system as recited in claim 29, wherein the parallel conductors are associated into groups.

45. The system as recited in claim 44, wherein the drivers associated with the parallel conductors in the groups are configured to produce drive currents at a first frequency and in different phases.

46. The system as recited in claim 45, wherein the phases are configured to prevent stationary null points in the energizing field.

47. The system as recited in claim 44, wherein the parallel conductors are associated into groups of n conductors and are configured to produce drive currents at a first frequency and in n phases.

48. The system as recited in claim 47, wherein parallel conductors in a same ordinal position in each group are driven with identical drive currents having identical frequencies and phases.

49. The system as recited in claim 48, wherein a sign of the drive currents in each group is opposite of a sign of the drive currents in an adjacent group.

50. The system as recited in claim 44, wherein the parallel conductors are associated into groups of three.

51. The system as recited in claim 50, wherein the drivers associated with the parallel conductors in the groups are configured to produce drive currents at a first frequency and in three phases.

52. The system as recited in claim 51, wherein the three phases are separated by 120 degrees.

53. The system as recited in claim 52, wherein each parallel conductor in a group is driven by a drive current that is 120 degrees out of phase with a drive current in an adjacent parallel conductor.

54. The system as recited in claim 53, wherein a sign of the drive currents in each group is opposite of a sign of the drive currents in an adjacent group.

55. The system as recited in claim 1, further comprising a second array of parallel conductors.

56. The system as recited in claim 55, wherein the second array of parallel conductors is orthogonal to the array of parallel conductors.

57. The system as recited in claim 55, wherein the second array of parallel conductors is parallel to the array of parallel conductors.

58. The system as recited in claim 57, wherein the second array of parallel conductors is out of phase with the array of parallel conductors.

59. The system as recited in claim 55, wherein the second array of parallel conductors is in phase quadrature with the array of parallel conductors.

60. The system as recited in claim 59, wherein at least one of the arrays of parallel conductors has constant spacing between the parallel conductors.

61. The system as recited in claim 59, wherein at least one of the arrays of parallel conductors has sinusoidally varying spacing between the parallel conductors.

62. The system as recited in claim 55, wherein the array of parallel conductors is placed in a first layer and the second array of parallel conductors is placed in a second layer.

63. A position detection system for locating an object including a resonator, comprising:

an array of parallel conductors responsive to a magnetic field generated by the resonator;

a plurality of drivers each associated with respective first and second parallel conductors, wherein the driver drives current in one direction through the first parallel conductor and drives current in an opposite direction through the second parallel conductor, to produce an energizing field; and

a plurality of receivers each connected to respective first and second parallel conductors.

64. The system as recited in claim 63, wherein the energizing field energizes the resonator to produce the magnetic field.

65. The system as recited in claim 64, wherein the magnetic field and energizing field have different frequencies.

66. The system as recited in claim 63, wherein the parallel conductors are spaced apart from one another in a sinusoidally varying manner.

67. The system as recited in claim 66, wherein the parallel conductors are oriented orthogonal to an axis along which the location of the object is measured, and the spacing of the parallel conductors varies according to a sine of each parallel conductor's position along the axis.

68. The system as recited in claim 63, wherein the parallel conductors are spaced apart from one another by a substantially constant spacing

69. A method for detecting position of an object including a resonator, comprising:

providing an array of parallel conductors responsive to the resonator;

providing a plurality of receivers; and

associating each receiver with a parallel conductor.

70. The method as recited in claim 69, further comprising configuring the array of parallel conductors to locate the object along a measurement path.

71. The method as recited in claim 70, wherein the measurement path comprises a measurement axis, and configuring the array of parallel conductors includes placing the array orthogonal to the measurement axis.

72. The method as recited in claim 69, further comprising providing a plurality of drivers.

73. The method as recited in claim 72, further comprising associating each driver with a parallel conductor.

74. The method as recited in claim 73, further comprising using each driver to drive current through the associated parallel conductor to produce an energizing field.

75. The method as recited in claim 69, further comprising using each receiver to receive current from the associated parallel conductor to sense magnetic flux from the resonator.

76. The method as recited in claim 69, wherein providing the array of parallel conductors includes spacing the parallel conductors apart by a constant spacing.

77. The method as recited in claim 69, wherein providing the array of parallel conductors includes spacing the parallel conductors apart by a sinusoidally variable spacing.

78. The method as recited in claim 77, wherein spacing the parallel conductors apart includes varying the spacing sinusoidally according to a position of each parallel conductor in the array of parallel conductors.

79. A method for detecting position of an object including a resonator in a position detection system including an array of parallel conductors and a plurality of drivers and receivers each associated with a parallel conductor, comprising:

disabling the receivers to avoid saturation;

enabling the drivers to provide current to the array of parallel conductors to generate a magnetic field and excite a resonator;

disabling the drivers and placing them in a high impedance state;

enabling the receivers;

receiving signals from the parallel conductors produced by the resonator through inductive coupling; and

computing the position of the resonator.

80. A computer program product for use in a position detection system including an array of parallel conductors and a plurality of drivers and receivers each associated with a parallel conductor, comprising a computer usable medium having machine readable code embodied therein for:

disabling the receivers to avoid saturation;

enabling the drivers to provide current to the array of parallel conductors to generate a magnetic field and excite a resonator;

disabling the drivers and placing them in a high impedance state;

enabling the receivers;

receiving signals from the parallel conductors produced by the resonator through inductive coupling; and

computing the position of the resonator.